Urinary tract infection in children
diagnosis, treatment and long-term management

**Urinary tract infections (UTIs) occur in 3–5% of girls and 1% of boys.**
**Urinary tract infections (UTIs) are caused mainly by colonic bacteria.**

**In females:** 75–90% of all infections are caused by *Escherichia coli*, followed by *Klebsiella* spp. and *Proteus* spp.

**In males:** Some series report that in males older than 1 yr of age, *Proteus* is as common a cause as *E. coli*; others report a preponderance of gram-positive organisms in males. *Staphylococcus saprophyticus* and enterococcus are pathogens in both sexes. Viral infections, particularly adenovirus, also may occur, especially as a cause of cystitis.

**CLINICAL MANIFESTATIONS AND CLASSIFICATION.**

The 3 basic forms of UTI are pyelonephritis, cystitis, and asymptomatic bacteriuria.

**Presenting symptoms and signs in infants and children with UTI**

**Infants younger than 3 months**
Fever, Vomiting, Lethargy, Irritability, Poor feeding, Failure to thrive
Least common Offensive urine

**Infants and children, 3 months or older**
Fever, Malaise, Vomit, Poor feeding, Cloudy urine, Irritability, Frequency Dysurea, Abdominal pain, Loin tenderness, Dysfunctional voiding, Changes to continence, hematuria. Offensive urine, Failure to thrive.

**Infants and children presenting with unexplained fever of 38 °C or higher should have a urine sample tested after 24 hours at the latest.**

**Pyelonephritis is characterized by any or all of the following**

- abdominal or flank pain, fever, malaise, nausea, vomiting, and, occasionally, diarrhea.
- Newborns may show nonspecific symptoms such as poor feeding, irritability, and weight loss.
- Pyelonephritis is the most common serious bacterial infection in infants <24 mo of age who have fever without a focus
- Acute pyelonephritis may result in renal injury, termed pyelonephritic scarring.
Cystitis: Indicates that there is bladder involvement
- symptoms include dysurea, urgency, frequency, Suprapubic pain, incontinence, and malodorous urine.
- Cystitis does not cause fever and does not result in renal injury

Asymptomatic bacteriuria:refers to a condition that results in a positive urine culture without any manifestations of infection.
- It is most common in girls.
- The incidence is 1–2% in preschool and school-age girls and 0.03% in boys.

PATHOGENESIS AND PATHOLOGY
- Virtually all UTIs are ascending infections. The bacteria arise from the fecal flora, colonize the perineum, and enter the bladder via the urethra.
- In uncircumcised boys, the bacterial pathogens arise from the flora beneath the prepuce.
- In some cases, the bacteria causing cystitis ascend to the kidney to cause pyelonephritis.
- Rarely, renal infection may occur by hematogenous spread, as in endocarditic or in some neonates.

Risk Factors for Urinary Tract Infection
- Female gender
- Uncircumcised male
- Vesicoureteral reflux
- Toilet training
- Voiding dysfunction
- Obstructive uropathy
- Urethral instrumentation
- Wiping from back to front in females
- Bubble bath?
- Tight clothing (underwear)
- Pinworm infestation
- Constipation
- Bacteria with P fimbriae
- Anatomic abnormality (labial adhesion)
- Neuropathic bladder
- Sexual activity  Pregnancy

DIAGNOSIS
- A UTI may be suspected based on symptoms or findings on urinalysis, or both, but a urine culture is necessary for confirmation and appropriate therapy.
- The correct diagnosis of UTI depends on having the proper sample of urine
There are several ways to obtain a urine sample; some are more accurate than others.

A clean catch urine sample is the recommended method for urine collection. If a clean catch urine sample is unobtainable:
• Other non-invasive methods such as urine collection bags should be used.
• When it is not possible or practical to collect urine by non invasive methods, catheter samples or Suprapubic aspiration (SPA) should be used.
• Before SPA is attempted, ultrasound guidance should be used to demonstrate the presence of urine in the bladder.

• In toilet-trained children, a midstream urine sample usually is satisfactory.
• If the culture shows >100,000 colonies of a single pathogen, or if there are 10,000 colonies and the child is symptomatic, the child is considered to have a UTI.
• In uncircumcised males, the prepuce must be retracted; if the prepuce is not retractable, this method of urine collection may be unreliable.

• Infants, the application of an adhesive, sealed, sterile collection bag after disinfection of the skin of the genitals can be useful, particularly if the culture is negative.
• A positive culture may reflect a contaminant, particularly in girls and uncircumcised boys. In such cases, if the urinalysis result is positive, the patient is symptomatic, and there is a single organism cultured with a colony count greater than 100,000, there is a presumed UTI.
• If any of these criteria are not met, confirmation of infection with a catheterized sample is recommended.

• Only a few milliliters need to be aspirated with a syringe to obtain the urine sample.
• Urinalysis should be obtained from the same specimen that was cultured.
• Pyuria (leukocytes in the urine) suggests infection, but infection can occur in the absence of pyuria; consequently, this finding is more confirmatory than diagnostic.
• With acute renal infection, leukocytosis, neutrophilia, and elevated erythrocyte sedimentation rate and C-reactive protein are common. The latter two are nonspecific markers of bacterial infection.
Acute management

**Antibiotic treatment**

- Acute cystitis should be treated promptly to prevent possible progression to pyelonephritis.
- If the symptoms are severe, a specimen of bladder urine is obtained for culture, and treatment is started immediately.
- If the symptoms are mild or the diagnosis is doubtful, treatment can be delayed until the results of culture are known.
- If treatment is initiated before the results of a culture and sensitivities are available, a 3- to 5-day course of therapy with trimethoprim-sulfamethoxazole is effective against most strains of *E. coli*.
- Nitrofurantoin (5–7 mg/kg/24 hr in 3 to 4 divided doses) also is effective and has the advantage of being active against *Klebsiella-Enterobacter* organisms.
- Amoxicillin (50 mg/kg/24 hr)

- acute febrile infections suggestive of pyelonephritis, a 10- to 14-day course of broad-spectrum antibiotics capable of reaching significant tissue levels is preferable.

**Children who should be admitted to the hospital**

- Dehydrated, vomiting, or are unable to drink fluids
- Children ≤1 mo of age
- Those whom urosepsis is a possibility should be admitted to the hospital for intravenous dehydration and intravenous antibiotic therapy.

- Parenteral treatment with ceftriaxone (50–75 mg/kg/24 hr, not to exceed 2 g) or ampicillin (100 mg/kg/24 hr) with an aminoglycoside such as gentamicin (3–5 mg/kg/24 hr in 1 to 3 divided doses) is preferable.
- The potential ototoxicity and nephrotoxicity of aminoglycosides should be considered, and serum creatinine Treatment with aminoglycosides is particularly effective against *Pseudomonas* spp., and alkalization of urine with sodium bicarbonate increases their effectiveness in the urinary tract. Oral 3rd-generation cephalosporins such as cefixime are as effective as parenteral ceftriaxone against a variety of gram-negative organisms other than *Pseudomonas*, and these medications are considered by some authorities to be the treatment of choice for oral therapy.
indications for long-term prophylaxis

**Antibiotic prophylaxis**
- Antibiotic prophylaxis should not be routinely recommended in infants and children following first-time UTI.
- Antibiotic prophylaxis may be considered in infants and children with recurrent UTI.
- Asymptomatic bacteriuria in infants and children should not be treated with prophylactic antibiotics.

**Definitions of atypical and recurrent UTI**

**Atypical UTI includes:**
- seriously ill (for more information refer to ‘Feverish illness in children’)
- poor urine flow
- abdominal or bladder mass
- raised creatinine
- septicaemia
- failure to respond to treatment with suitable antibiotics within 48 hours
- infection with non-*E. coli* organisms.

**Recurrent UTI:**
- two or more episodes of acute pyelonephritis
- one episode of acute pyelonephritis plus one or more episode of cystitis
- three or more episodes of cystitis

**.neurogenic bladder,**
- **urinary tract stasis and obstruction,**
- **reflux, calculi**
- using sulfamethoxazole-trimethoprim, trimethoprim, or nitrofurantoin at ⅓ of the normal therapeutic dose once a day, often is effective. Prophylaxis with amoxicillin or cephalexin also may be effective, but the risk of breakthrough UTI may be higher because bacterial resistance may be induced

- The **main consequences** of chronic renal damage caused by pyelonephritis are **arterial hypertension** and **renal insufficiency**; when they are found they should be treated appropriately

**Imaging tests**
Infants and children with atypical UTI should have ultrasound of the urinary tract during the acute infection to identify structural abnormalities of the urinary tract such as obstruction.
- For infants **younger than 6 months** with first-time UTI that responds to treatment, ultrasound should be carried out within 6 weeks of the UTI.
- For infants and children 6 months or older with first-time UTI that responds to treatment, routine ultrasound is not recommended unless the infant or child has atypical UTI.
- Infants and children who have had a lower urinary tract infection should undergo ultrasound (within 6 weeks) only if they are younger than 6 months or have had recurrent infections.
- A DMSA scan 4–6 months following the acute infection should be used to detect renal parenchymal defects.

If the infant or child has a subsequent UTI while awaiting DMSA, the timing of the DMSA should be reviewed and consideration given to doing it sooner.

### Recommended imaging schedule for infants younger than 6 months

<table>
<thead>
<tr>
<th>Test</th>
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<th>Atypical UTI</th>
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<tbody>
<tr>
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<tr>
<td>DMSA 4–6 months following the acute infection</td>
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</tr>
<tr>
<td>MCUU</td>
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### Recommended imaging schedule for infants and children 6 months or older but younger than 3 years

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### Recommended imaging schedule for children 3 years or older

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Follow-up

- Infants and children who have recurrent UTI or abnormal imaging results should be assessed by a pediatric specialist.

- Assessment of infants and children with renal parenchymal defects should include height, weight, blood pressure and routine testing for proteinuria.

- Infants and children who have bilateral renal abnormalities, impaired kidney function, raised blood pressure and/or proteinuria should receive monitoring and appropriate management by a pediatric nephrologist to slow the progression of chronic kidney disease.

- Asymptomatic bacteriuria is not an indication for follow-up

Infants younger than 3 months with a possible UTI should be referred immediately to the care of a paediatric specialist. Treatment should be with intravenous (IV) antibiotics in line with ‘Feverish illness in children’

For infants and children 3 months or older with acute pyelonephritis/upper urinary tract infection:
- Consider referral to secondary care.
- Treat with oral antibiotics for 7–10 days. The use of an oral antibiotic with low resistance patterns is recommended, for example, cephalosporin or co-amoxiclav.
- If oral antibiotics cannot be used, treat with an IV antibiotic agent such as cefotaxime or ceftriaxone for 2–4 days followed by oral antibiotics for a total duration of 10 days.

For infants and children 3 months or older with cystitis/lower urinary tract infection:
- Treat with oral antibiotics for 3 days. The choice of antibiotics should be directed by locally developed multidisciplinary guidance. Trimethoprim, nitrofurantoin, cephalosporin or amoxicillin may be suitable.
- The parents should be advised to bring the infant or child for reassessment if the infant or child is still unwell after 24–48 hours.

If an alternative diagnosis is not made, a urine sample should be sent for culture to identify the presence of bacteria and determine antibiotic sensitivity if urine culture has not already been carried out.

If parenteral treatment is required and IV treatment is not possible, intramuscular treatment should be considered.
If an infant or child is receiving prophylactic medication and develops an infection, treatment should be with a different antibiotic, not a higher dose of the same antibiotic.
Asymptomatic bacteriuria in infants and children should not be treated with antibiotics. Laboratories should monitor resistance patterns of urinary pathogens and make this information routinely available to prescribers.